AutoCAD Civil 3D 2010
Education Curriculum Instructor Guide, Unit Overview
Unit 4: Environmental Design

Autodesk

Unit 4 – Environmental Design

Unit 4 addresses the topics of environmental and sustainable design. It is important to understand that it is the decisions made during planning, detailed design, and construction project activity that contribute to sustainable designs. Technology provides the tools that enable an engineer to generate and analyze the planning and design alternatives. Furthermore, it should be noted that the ability to affect environmental impacts and also total cost of a project decreases as the project progresses through its various phases. For example, during the planning phase of engineering projects there is more flexibility to make important decisions and choices that affect the overall course of the design. Once the project reaches the detailed design phases there is less that can be done to affect the sustainability and environmental impacts of the design. Once the project goes to construction, the opportunities, beyond standard construction procedures, are even less.

Sustainable design is a design philosophy that complies with the principles of environmental, economic, social, and ecological sustainability. The lessons in this unit demonstrate how AutoCAD® Civil 3D® software can be used to design projects taking into consideration sustainability and environmental impacts.

The lessons contained in Unit 3 include the following:

- Lesson 1 – Sustainable Design
- Lesson 2 – Watershed Modeling
- Lesson 3 – Pipe Design
- Lesson 4 – Integrating Architectural and Site Design

Lesson 1 discusses sustainable design concepts in detail, and offers exercises that demonstrate how Civil 3D can be applied to projects that incorporate sustainable design principles. Lesson 2 shows students how to analyze watersheds on a surface model. Lesson 3 discusses storm sewer layout and design using Civil 3D. Finally, lesson 4 discusses how students can integrate a building model from Autodesk® Revit® Architecture software with an AutoCAD Civil 3D model.

A detailed summary of the lessons in Unit 4 follows:

Lesson 1 - Sustainable Design

In this lesson, students learn about basic hydrology, storm water concepts, and sustainable design as they relate to site engineering. In the fields of civil engineering and land development design, the term *sustainable design* refers to applying new methods to reduce the quantity of storm water, improve the quality of storm water, reduce erosion of soil, and infiltrate more storm water to recharge groundwater aquifers. Through the process of designing improvements to a parcel of land, a knowledgeable engineer can minimize the impact of changing the land cover by using sustainable design techniques.

Objectives

After completing this lesson, students will be able to:

- Describe the hydrologic cycle and perform basic surface runoff calculations.
- Describe the impact of land cover on surface water runoff.
- Describe important site considerations in sustainable design.
- Describe different types of strategies for sustainable design.
- Visualize the flow path for storm water runoff.
- Modify surface to alter the surface water flow direction.
- Create a rain garden.

Exercises

The following exercises are provided in a step-by-step format in this lesson:

1. Visualize Flow Patterns
2. Visualize Roadway Drainage
3. Create a Rain Garden

Lesson 2 – Watershed Analysis

In this lesson, students learn how Civil 3D is used to analyze surface water runoff in a watershed. Hydrologic analysis begins with a close inspection of the terrain surface. A watershed is the total area of land that contributes surface runoff to a particular point of interest. A defined surface in Civil 3D may or may not entirely contain a watershed. Using the Watershed Analysis and Water Drop tools can help determine where surface water flows on the surface. Along with other factors such as soil type, slope, and land cover, the area of a watershed is necessary to calculate surface runoff flow rate.

Objectives

After completing this lesson, students will be able to:

- Describe the different types of watersheds delineated by Civil 3D.
- Use watershed analysis to delineate watershed boundaries.
- Create surface water runoff paths.

Exercises

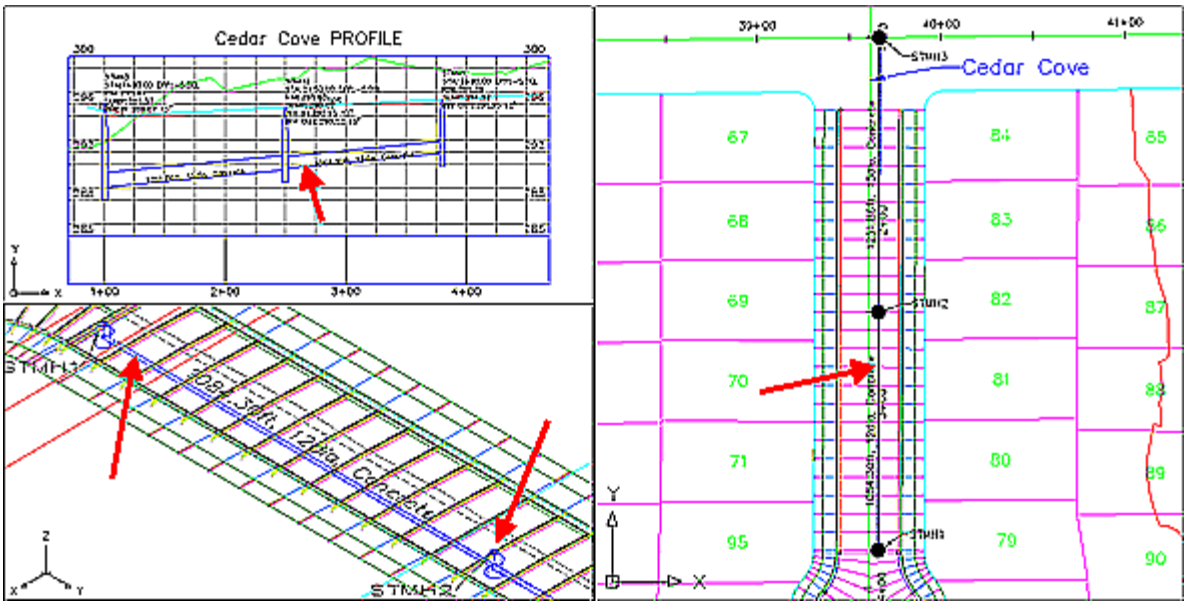
The following exercises are provided in a step-by-step format in this lesson:

1. Delineate Watersheds
2. Visualize Runoff Paths

Lesson 3 – Pipe Design

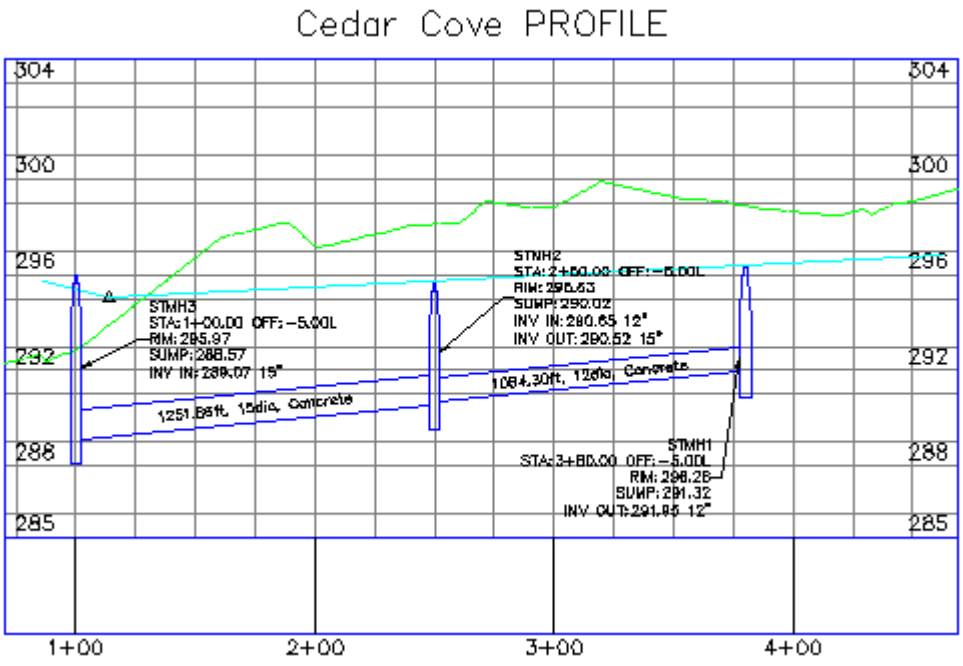
In this lesson, students learn how to add pipes and structures to a pipe network in plan view and in profile view. Students also learn how to label the pipes and structures in both views. The Hydraflow Storm Sewers Extension is used to calculate pipe sizes and invert elevations for a pipe network. Students create a pipe network to model storm sewer, sanitary sewer, and watermain systems. By creating a 3D model of a pipe network, you can quickly explore different design alternatives and check for interferences with other subsurface features.

The following illustration shows a pipe network in plan, profile, and 3D views. The arrows indicate the pipe network.



When you draw pipe network parts in profile view, you can evaluate the engineering attributes of your design. You can also customize the appearance of labels to help you design, or meet internal or client CAD standards requirements. When you edit pipe network data, the pipe network objects and labels in plan and profile view automatically update to reflect your revisions. This makes it very easy to generate and evaluate alternatives during the planning and detailed design processes. Furthermore, when you edit the plan view location of pipe network parts, the pipe network parts in the profile view automatically update.

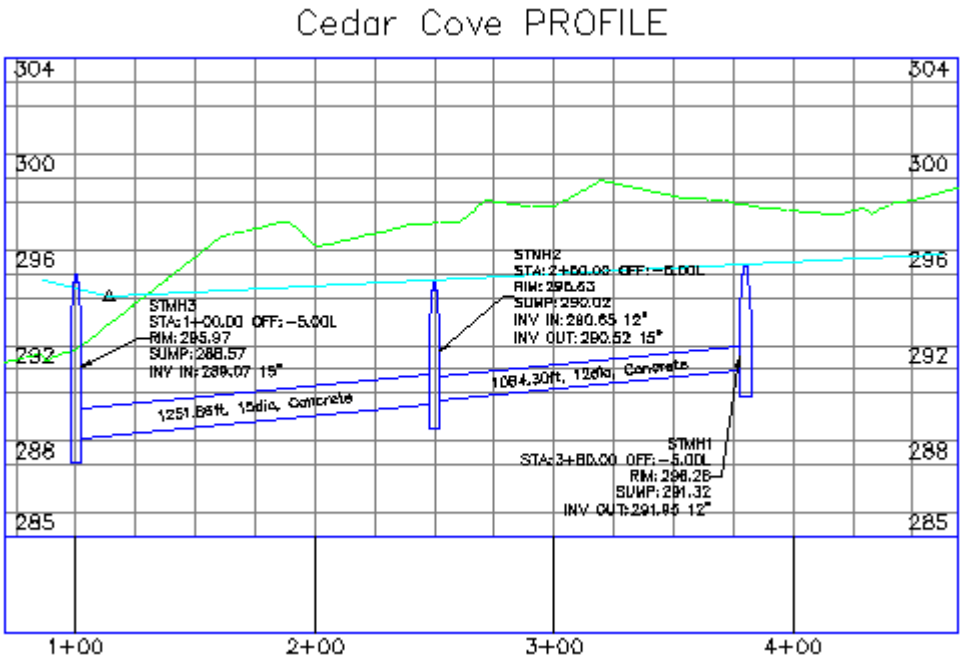
The following illustration shows a pipe network in a profile view.



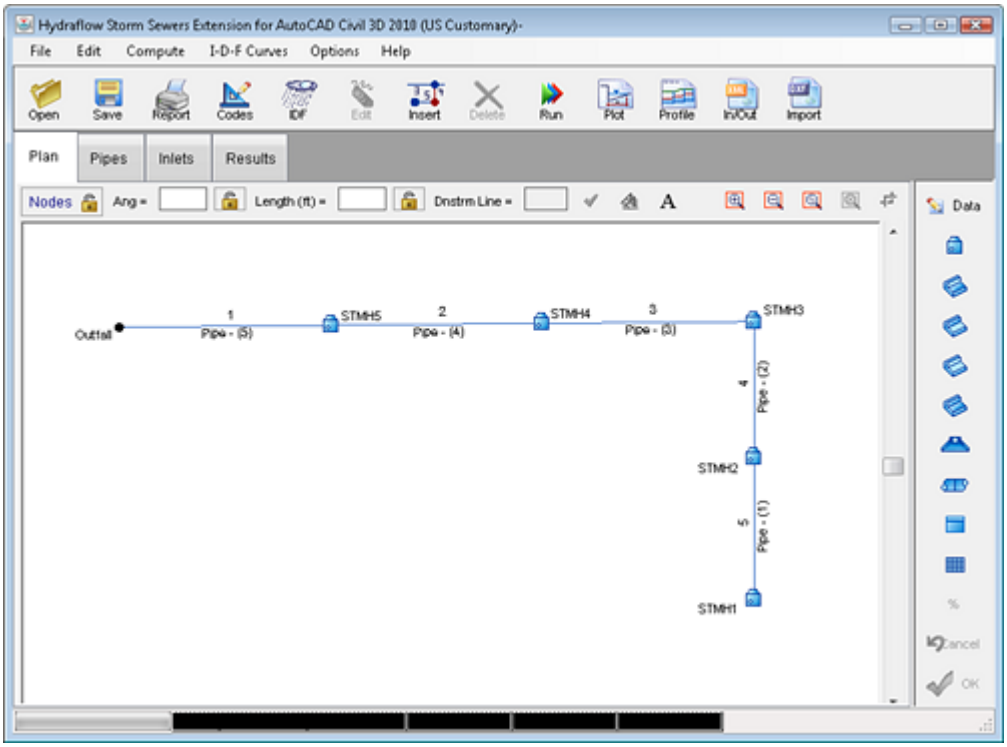
When you label a pipe network, you display the engineering data that you need to complete and evaluate the design and to construct the pipe network. Pipe labels can be created when you

create the pipe network or after you create the pipe network. Pipe labels automatically update when you make changes to the pipe network.

The following illustration shows a labeled pipe network.



The Hydraflow Storm Sewers Extension is a powerful tool to calculate pipe sizes and invert elevations for a storm sewer pipe network.



Objectives

After completing this lesson, students will be able to:

- Describe the characteristics and function of pipe network objects.
- List the steps for creating pipe networks.
- Create a storm sewer pipe network for Cedar Cove.
- Draw a pipe network in profile view.
- Edit the pipe network.
- Label pipe networks.
- Design a storm sewer network that includes pipe sizes and invert elevations.

Exercises

The following exercises are provided in a step-by-step format in this lesson:

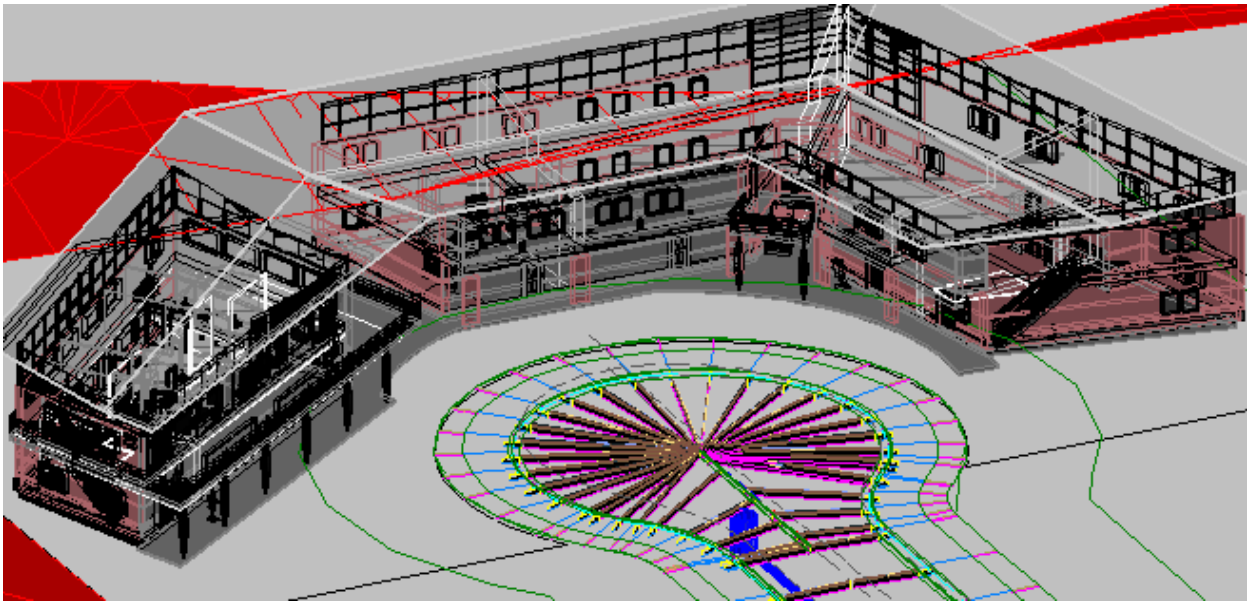
1. Create a Pipe Network
2. Draw Pipes in Profile View
3. Edit a Pipe Network
4. Label Pipes
5. Design a Storm Sewer

Lesson 4 – Integrating Architecture and Site Design

In this lesson, students learn how to combine building design data with civil engineering design data. In some circumstances it is helpful to be able to visualize both the architectural and civil engineering components of a project at the same time. Architectural data typically consists of information above the ground, and includes buildings as well as all of the components within buildings. Civil engineering data usually consists of information representing the ground surface and below, and can include roads, site grading, and sewers.

Large site development projects often involve a public participation process, where the public and other interest groups are given the opportunity to provide input on a proposed project. A very effective means to portray the intent of a project is to use 3D visualization techniques.

When you combine architectural and site design data, you get an accurate representation of the proposed works for both above ground and below ground construction. This is shown in the following illustration:



Objectives

After completing this lesson, students will be able to:

- Describe the Autodesk Revit Architecture application.
- Explain how to incorporate a Revit building model with a Civil 3D site design model.
- View a model in 3D.

Exercises

The following exercise is provided in a step-by-step format in this lesson:

1. Insert a Revit Model